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THE
ONTARIO WATER RESOURCES COMMISSION

Abstract of
A
REPORT ON

Water Supplies
Lambton County

BY:

C. G. Russel Armstrong

DATE:

September 12, 1957

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Abstract of a report on water supplies for municipalities in Lambton County. Russell
Armstrong, C. G.

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a Report on

WATER SUPPLIES FOR MUNICIPALITIES IN LAMBTON COUNTY

Report by

C.G. Russell Armstrong,

Consulting Engineer,

Windsor, Ontario.

Sept. 12th, 1957.

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An Abstract of a Report by C. G. Russell Armstrong,
Consulting Engineer - Windsor, Ontario.
On water supplies for Municipalities in Lambton County.

This Report deals with the means and cost for providing water for different Municipalities in Lambton County, excluding the City of Sarnia. The following information is supplied on water for each of the Municipalities.

TOWN OF PETROLIA.

Water for Petrolia is obtained from Lake Huron where an intake and pumphouse is located at Bright's Grove. This system was established in 1896. The present intake consists of a 16" Cast Iron pipe Twelve Hundred and Eighty feet (1,280') long, terminating in about Twenty feet of water. This present intake was constructed about fourteen years ago. The trunk main from the pumphouse to the town consists of a 12" Cast Iron main about Twelve and one-half miles long. There is a 750,000 gallon surge tank situated on Lot 7, Concession 1, in the Township of Plympton. There is also a standpipe in the town which has a capacity of 250,000 gallons. The average demand is 300 g.p.m. with a maximum of one and one half million gallons per day. The population of the town is 3,400.

There is evidence that this trunk line has been giving trouble due to the occurrence of several leaks. It is also understood that repairs to this trunk line have had to be made frequently in the last few years. About five years ago the Public Utilities Commission replaced three-quarters of a mile of this main in one location. There is also evidence that there are barnacles on the inside of the main. All this tends to show that the original

carrying capacity of the mains must be materially reduced since it was constructed, and also there is evidence that the maintenance of this main is soon going to be quite considerable. There is further evidence that the carrying capacity of this main may not be increased by the use of additional pressure, because the main is no longer capable of withstanding increased pressures. In short, the main is nearing its normal life expectancy, and can no longer be counted on to deliver an assured supply of water over a long period of time.

Inquiries from the Petrolia Public Utilities Commission revealed that it charges farms who use water along the route at the rate of 64 cts. per 1,000 gallons for the first 50,000 gallons; 54 cts. per 1,000 gallons for the second 50,000 gallons; 45 cts. per 1,000 gallons for the next 100,000 gallons; and the remainder at the rate of 36 cts. per 1,000 gallons, and $12.00 per year for a pasture tap. The domestic rate to the town ratepayers is about 43 cts. per 1,000 gallons where meters are in existence. The greater portion of the town is not metered, and a flat rate charge is made of about $25.00 per year on the average. The charge for water to industry is at the rate of 21.6 cts. per 1,000 gallons.

The Petrolia Public Utilities Commission furnishes water to quite an extensive lake frontage on Lake Huron, both east and west of the pumphouse, from approximately Blackwell on the west to the Village of Camlachie on the east. There is a separate pumping station at the lake pumphouse to furnish the above described area fronting on Lake Huron. The treatment given to this water supplied by the Petrolia P.U.C. consists of prechlorination, coagulation, and settling, and post-chlorination.

In summary, it seems evident to us that the Petrolia system should not be taxed beyond its present capacity, due to the age and condition of the long supply main from the Lake to the Town. It is possible that the Village of Wyoming, which is within four miles of the supply main, could be serviced with an adequate supply from this system, without severely overloading it and placing any threat to its lifetime. It does not seem feasible, however, to suggest that any other major consumer of water should depend on this pipeline for a source of supply over a long period of time such as is required to amortize debt charges financed by the Ontario Water Resources Commission. The system along the shore of Lake Huron which is pumped from the Petrolia pumphouse is not threatened by a short lifetime of the pipe, but rather is incapable of future expansion due to the inadequacy of the mains that have been laid to date.

VILLAGE OF WYOMING

The population of the Village of Wyoming in the year 1956 was 771, and there has been little growth over a period of time. Two principal businesses are the Swifts plant and the milling company grain elevator. About 50% of the people have surface wells dug to a depth of approximately 20 ft. There are several drilled wells about 100 ft. in depth. It was reported that the quality of the greater part of the water was fresh and in sufficient supply for the normal needs of the Village.

The most feasible source of water for Wyoming is from the Petrolia pipe line. It is expected that any proposal that will bring water to the community at a reasonable cost will receive careful consideration.

VILLAGE OF ALVINSTON

The population of Alvinston is listed as 675. This has remained static for a number of years. A few watermains were laid in the village about the year 1914, with fire hydrants and house connections. The source of supply is the Sydenham River, and is untreated. The water is meant to be used for toilets, lawn watering, and fire protection. The drinking water for the village is obtained from shallow wells generally about 15 ft. deep, which normally provide sufficient water for the requirements of the householders. A few drilled wells are in existence, and these obtain water from a gravel strata lying immediately above the bed rock approximately 100 ft. below ground surface. Generally speaking, the drilled wells are salty, and do not provide an adequate supply. The public tends to supplement the water supply by the use of untreated river water, and this creates a serious health hazard. Very few of the shallow wells in the village have been passed as fit for drinking purposes.

It is unfortunate that, due to its location, it is not practical from an economical standpoint to supply this municipality with water taken from Lake Huron or from the St. Clair River. It would seem that water supply for Alvinston must be to locate a suitable well as close to the municipality as is feasible. Up to date this supply has not been located. We would therefore respectfully suggest that further efforts be made to locate such a well supply for the Village.

VILLAGE OF ARKONA

This municipality has a population of 427, and a general

assessment of $359,205.00. It is dependent on individual shallow and deep wells for water supply.

It is interesting to note that in the only survey made of all the wells in this community 73 wells or 73.7% were grossly polluted at the time of sampling, and 20 wells or 20.2% were less seriously contaminated. Only one well in the whole community was free from pollution at the time of sampling. There is thus every evidence from that survey that a water supply is needed for health protection and sanitation. There have also been occasions when water shortages have occurred in the wells. During these periods there was some demand for a water supply but no action was taken at that time.

Arkona needs a public water works system to ensure the protection of health, to provide fire protection, and to assure continuous water for the community. In the event that a water supply is installed here, it will in all probability be from a well.

VILLAGE OF THEDFORD

In a meeting with the local officials it was thought that the Village of Thedford could possibly obtain a water supply from ground water sources either to the south of the village in a location near lots 14 and 15, Concession 3, in the Township of Bosanquet, or somewhere near Lots 28 and 29, Concession 3 in this same Township. The water level in the wells in the immediate area around the village is indicated as being consistently down over the years, and wells have gone dry during the summer. The village had an engineering report on a water supply in 1939. This report indicated that a well supply could furnish water to the village from a source at Lot 15,

Concession 3, in the Township of Bosanquet. The population of the village is 700 persons, and has been growing steadily at the rate of about 10 persons per year. There are approximately 210 houses in the village at the present time. Industries in the village consist of a lumber mill, a tile plant, a brickyard, and a cold storage plant.

The assessment of Thedford is approximately $400,000.00, and the debenture debt is $19,000.00. There was an indication by industry that industry would use a fair amount of water and would sooner obtain this from the village than try to obtain it from separate sources. There appeared to be a lively interest in a water supply for this community. Information on water works for the Village of Thedford is contained in Appendices 1, 11, and 111. These costs are predicated on a satisfactory supply of water being obtained on the two above-mentioned alternative sites.

It will be noted that in Appendix 1, the estimated cost of a water supply obtained in Lots 14 and 15, Concession 3, in the Township of Bosanquet, is $56,640.00. This produces a total annual charge to pay off the debt and operating of the pumping station of $6,157.00. It is estimated that a population of 700 persons would use approximately 56,000 gallons of water per day, based on a consumption of 80 gallons per person per day. On this assumption, the total estimated yearly amount for the village would be approximately 20,500,000 gallons. The cost of water to the village therefore would be approximately 30 cts. per 1,000 gallons.

From Appendix 11, being the estimate of the cost of furnishing a supply of water from Lots 28 and 29, Concession 3, in the

Consumers 2, at the Township of Lakewood. The completion of the project in the [illegible] [illegible] [illegible] of the [illegible] of which [illegible] [illegible] and [illegible] [illegible] the [illegible] in the [illegible] [illegible] and [illegible] [illegible] in the [illegible] [illegible] of [illegible] [illegible], [illegible], and a well [illegible] plant.

The [illegible] of [illegible] is approximately $300,000, and the [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] by [illegible] [illegible] [illegible], [illegible] of water and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. It [illegible] [illegible] [illegible] as a [illegible] [illegible] in a [illegible] for [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] 2, 3, and 4. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

[illegible] [illegible] [illegible] [illegible] 3, [illegible] [illegible] [illegible] [illegible] [illegible] 3, in the Township of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] approximately [illegible] [illegible]. The [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

[illegible] [illegible] 11, [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible] of water [illegible] [illegible] [illegible] [illegible], [illegible] in the

Township of Bosanquet, it can be seen that the total estimated cost of such a supply would be $77,000.00. This is a substantial increase over the supply from the south, mainly caused by the fact that this supply is located at a much lower elevation than the southern supply, and is a little more distant from the Village of Thedford. Consequently, it has been found necessary to increase the size of the supply main from a 6" to an 8" pipe. The estimated annual charges for this system, as shown in Appendix 11, are $7,937.00, and based on an estimated annual consumption of 20,500,000 gallons, the cost of water would be 38.7 cts. per 1,000 gallons.

In Appendix 111, we have estimated the cost of constructing an internal distribution system of watermains within the Village of Thedford. Upon the advice of the Clerk of the Village of Thedford we have estimated that 198 houses would use water from such a system. The total estimate for an internal system is $106,467.00. After deducting the cost of private service connections, which will be chargeable directly to the property receiving same, we arrive at a total annual charge of $11,065.00, which, based on a consumption of 20,500,000 gallons per year, indicates a charge of 54.0 cts. per 1,000 gallons required to pay off the internal distribution system, if no charge is made on an assessment basis.

It is possible that the Village might wish to finance a part of this cost on the assessment of the village at large, in view of the fact that values on real estate will certainly be enhanced by the installation of such a system.

VILLAGE OF WATFORD

The population of this village is 1,200, and the growth

has been rather small. The Industrial requirements are the Imperial Poultry Company, which uses about 35,000 gallons per day, and has its own well. There is also the wire factory, which has its own well. The total present consumption is approximately 26 million gallons a year. The average daily consumption is 40,000 to 50,000 gallons, and the maximum daily consumption is 115,000 gallons. The village obtains its water from three drilled wells which are about 150 ft. deep. These wells are now producing less than 38 gallons per minute each, and the water levels stand at 103 ft. below ground level. The source of supply seems to be in a very thin bed of gravel over the rock. The hardness of the water is below 200, and there is a high content of sulphur. The village has a de-gasifier, and the water is aerated in the open storage reservoir and chlorinated for taste control.

The village has a 230,000 gallon ground water storage tank, and 15,000 gallon elevated tank, 80 ft. high. The pressure required at the pumphouse is approximately 30 lbs. In spite of an earnest endeavour by the Public Utilities Commission to augment the present supply, little success has been attained. Moreover, the taste and colour of the water leaves much to be desired. It is true that the Public Utilities Commission drilled one well which produced a reasonable supply of water, but it had the effect of lowering the water table in all the wells in the adjoining area. Due to the complaints of the residents in the immediate vicinity, the P.U.C. refrained from any further pumping from this well. There have also been seven test holes made in the last four years, none of which has given too much promise of a good supply. These wells might also affect the

wells of the surrounding farms if heavy pumping were carried out.

We have made inspections of a possible site from which ground water might be obtained in sufficient quantity and of suitable quality at a site in an old gravel pit about four miles east and one mile north of Watford. Indications are favourable for a sufficient supply from this site provided the area was carefully test-pumped in order that the amount of water could be determined in advance.

There are two other alternative sources of supply for the Village of Watford, and one might consider the advisability of obtaining water from the trunk line on the Petrolia system. This would involve the construction of over fifteen miles of main, and from our study of the condition of the Petrolia system we are hesitant in recommending that any supply for the Village of Watford be obtained from this system.

There is the other source of supply, which, to all outward appearances would seem to be quite a logical one. This is a joint supply with the Town of Forest from Lake Huron by way of an intake proposed in the vicinity of Hillsborough, which is on the Townline between Bosanquet Township and Plympton Township, with a trunk line to Forest about four and one-half or five miles distant and a cross-country line from Forest to Watford, which would be approximately eleven and one-half miles further.

We have investigated the economics of such a system, and under separate appendices have set out these estimated costs. Appendix lV sets out the estimated cost of a joint water line with the Town of Forest, having a lake supply. It will be noted that the

total capital cost of this proposal is $949,000.00. Basing Watford's share of the joint annual charges on an estimated annual consumption of 26 m.g., and charging Watford with the direct annual charges related to it, the total annual amount chargeable to the Village of Watford for participation in such a scheme would be $62,727.00. This would give a cost of water of $2.41 per 1,000 gallons, which is very high.

On the other hand, if a ground water supply is developed from the gravel ridge as herein before described, the estimated cost of which is outlined in Appendix V, it will be noted that the total estimated cost is $176,810.00, with total annual charges amounting to $17,570.00. Based upon an annual consumption of 26 million gallons per year, the cost of water from this source would be 67.6 cts. per 1,000 gallons, which is a considerable reduction from a lake supply and in our opinion merits a serious study of the possibilities of being able to develop a ground water supply at a location not too far distant from the Village of Watford.

TOWN OF FOREST

A meeting with the local officials revealed that the level of the water in their wells had been consistently falling over the past ten years. Attempts have been made at re-charging these wells from a source in a gravel pit southwest of the town. The Town of Forest is not yet in desperate need of water, but in the light of the observations made by the town officials it is evident that the lowering of the water level in the wells will one day reach a point where the system will no longer function. For this reason there is

interest in considering any proposals for furnishing Forest with an adequate water supply which in general opinion must come from Lake Huron. It was also revealed that any water supplied to the Town of Forest must be equal in quality and quantity to that which they are receiving at the present time.

The Town of Forest has a population of 2,000 persons, and appears to be growing at a rate of 100 persons per year. There are two main industries, namely a basket factory and a canning factory, which use up to 100,000 gallons per day. The town has quite a number of wells, all located within a very short distance of each other, and none of which is a very high producer of water. The wells are pumped by means of air-lifts into a common collector chamber, from whence the water is pumped to the distribution system and the reservoir and standpipe in the town.

It was hoped by the town officials that the experiment in re-charging the wells from the gravel pit at the southwest side of the town would be successful in maintaining the water level in the wells for a number of years to come. There was not conclusive evidence at this time to indicate that this re-charging would be successful, but at the same time there has not been evidence to indicate that it is unsuccessful. If re-charging is successful it is a foregone conclusion that the water can be obtained much cheaper than would be possible if a lake supply were to be brought in from Lake Huron.

The estimated cost of a joint lake supply in conjunction with a supply to the Town of Watford, is shown in Appendix lV, wherein it will be noted that the cost of water to Forest in this scheme would

be as much as 98.3 cts. per 1,000 gallons, or approximately $50.00 per connection per year. We have further estimated the cost of a lake water supply for the Town of Forest only, as shown in Appendix Vl. It will be noted here that the cost of water to the Town of Forest by this means would be $1.25 per 1,000 gallons. Both of these estimated costs are considerably in excess of the present rate paid by the consumers in the Town of Forest, being 35 cts. per 1,000 gallons for the first 3,500 gallons and 25 cts. per 1,000 gallons for the remainder.

In summary we would advise that the Town of Forest make every effort to continue to re-charge its wells, and even to augment the supply of re-charge water if at all possible, in an effort to delay the time when a lake supply will become absolutely necessary.

POLICE VILLAGE OF BRIGDEN

The population of Brigden is given as 499. The assessment is $234,012.00. The Police Village of Brigden can hardly be considered on its own, since any expenditure of size would have to be financed through the Township of Moore and in this Township there is also the Village of Corunna, with a population of 1,405. The Township of Moore, including Corunna and Brigden, has a population of 5,116. The assessment for Corunna is $481,560.00 and a combined assessment for the Township of Moore, including the municipalities of Corunna and Brigden, is $6,901,960.00, and the present municipal debt is $750,000.00.

The Police Village of Brigden has experienced very little growth in the past. It has no industry of note. The municipality has seven drilled wells, only four of which are producing at the

present time. The Village has a ground reservoir holding 70,000 gallons. The wells have a very small capacity for producing water, and in fact it is said that from one of the wells the discharge is as low as 1-1/2 gallons per minute. These wells are from 100 to 127 feet deep, with one well having a depth of 229 ft. Four wells are within 2,000 ft., and the original test on these wells showed a production of five to seven gallons per minute, but after six months the production from these wells dropped to three gallons per minute, and now shortly after the well has been pumped the capacity of the well in many places is less than two gallons per minute. The result has been that the village is in dire need of water, and has been forced to haul water at a rate of $6.00 per 1,000 gallons in the year 1955. The municipality drilled as many as nine holes in one summer, eight of which were dry. The village has meters on their present water system, and charges 50 cts. per 1,000 gallons when water is available. The maximum demand of the village has been from eight to ten thousand gallons per day. This figure is no doubt very low, due to the fact that the ratepayers are conscious of the scarcity of water, and we believe that if sufficient water were made available to this village it should not be less than 50,000 gallons per day, and it would be better to estimate an ultimate consumption of 100,000 gallons per day. As noted above, Brigden, up to the time we last investigated, had very, very little success in the matter of ground water supplies. We understand however that the municipal officials are constantly on the alert, and we believe they are making a concerted effort to secure an adequate ground water supply within a reasonable distance of the village.

[illegible] production [illegible] the present [illegible] well has [illegible] been [illegible] pressure [illegible]

The suggestion has been made that Brigden might obtain a supply of water from Petrolia by way of a long cross-country pipeline, or from a source of supply along the St.Clair River, either from a new intake constructed therefrom or from a water supply from the City of Sarnia. The third alternative is to investigate the possibility of a more extensive drilling program in a water area around the Village of Brigden. We have accordingly made estimates of the costs of supplying water firstly from Petrolia and secondly from the St. Clair River. We append these estimates herewith as Appendices Vll, Vlll, and lX. Appendix Vll deals with the supply of water from Petrolia by way of a long 8" watermain approximately eight and one-half miles in length. As can be seen, the cost of water from this source is estimated at $1.85 per 1,000 gallons. Appendix Vlll deals with the possibility of obtaining a water supply from a long pipeline from the St. Clair River, with an intake and treatment plant located at Mooretown, servicing the Villages of Corunna, Mooretown, Courtright, Brigden, and the western part of the Township of Moore fronting along the east shore of the St. Clair River. We are informed that the population of Courtright is 500, and that of Mooretown 150, together with approximately 100 houses along the highway between Corunna and Mooretown. The cost of water from this source to the Village of Brigden would be $2.06 per 1,000 gallons.

Similarly, we have estimated the cost of water from a City of Sarnia supply, which we have shown on Appendix lX. The cost of water from this source to the Village of Brigden would be $2.35 per 1,000 gallons.

Taking into consideration all the foregoing facts, we

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are of the opinion that the trustees of the Police Village of Brigden should make a further effort to obtain an adequate ground water supply even to the extent of having to go two or three miles distant from the village, preferably west, even as far as the hamlet of Kimball, which is on a direct line between Brigden and Courtney on the St. Clair River. Such a trunk line from the vicinity of Kimball could eventually become a part of an integrated system that some time in the future will no doubt take its water supply either from the St. Clair River in the vicinity of Mooretown and Courtright, or could even go as far as to be supplied by the system of metropolitan Sarnia. Certainly there should be an extensive drilling program carried out in a more expanded area than has been heretofore attempted.

MOORE TOWNSHIP AND AREAS ADJOINING METROPOLITAN AREA OF THE CITY OF SARNIA

We find that there is now a 10" line from the City of Sarnia to Corunna, which terminates somewhere near the north limit of Lot 64 in the Front Concession in Moore Township. Through an agreement, Moore Township obtains city water from the Sarnia system through the Canadian Oil Company. The City of Sarnia also now serves water to the east out the London Road to the Sideroad between Lots 12 and 13 in the Township of Sarnia. The City of Sarnia has under advisement the making of several large extensions to its present water works system, and when the same are completed, the City of Sarnia will no doubt be in a favourable position to serve water to all the remaining Sarnia Township area fronting on Lake Huron that is not now served with water, and of course will have an adequate supply to serve water

to that part of Sarnia Township in our opinion extending easterly to at least the Sideroad between Lots 9 and 10 in the Township of Sarnia, and as far south as the Townline Road between the Townships of Sarnia and Moore.

Dealing with the possibility of the future service to the front part of Moore Township, we have no hesitancy in saying that the system as now being improved in the City of Sarnia, with the small expenditures that will be incurred in Moore Township, will be in a position to adequately serve the front part of that Township within an area as far south as the line between Concessions 3 and 4 in the Township of Moore, and at least as far east as the Sideroad between Lots 18 and 19 in the Township of Moore. In other words it would appear that the metropolitan Sarnia water area can be visualized in the future to extend to meet the water area that might be set up around the area of Brigden. In our opinion, any small municipality within this last described area need have no concern about being able to procure an adequate and safe water supply.

At the present time the City of Sarnia restricts the use of water sold to Moore Township to residential and commercial consumers. Any use for industrial purposes must be approved by the City of Sarnia. No doubt in the future, as further growth takes place in the area and the use of water becomes more prevalent in Moore Township and the supply from the City of Sarnia is more greatly augmented, these restrictions will cease to be imposed on the Township of Moore. In conclusion, it does not seem logical that the Villages of Courtright, Mooretown, and Corunna, and that portion of Moore Township fronting on the St. Clair River should have to

construct an individual intake in the St. Clair River for the reason stated herein and for the further reason that the source of supply in the St. Clair River is quite likely to be far more contaminated by industrial pollution than the source of supply now enjoyed by the City of Sarnia at the junction of the St. Clair River and Lake Huron.

We submit herewith an overall plan of the County of Lambton on which we have indicated various proposals in different colours. We also submit detailed plans of a proposed interior water works system for the Village of Thedford.

APPENDIX I

ESTIMATE OF COST

of a WATER SUPPLY for the VILLAGE OF THEDFORD
from a possible well supply near Lots 14 & 15. Con. 3.
in the TOWNSHIP of BOSANQUET

Purchase of well sites & other necessary lands - -	$ 1,000.00
Drilling & casing of well, etc; pump and motor; pumphouse; power supply line; chlorinator; controls; meter, valves & piping; complete including fencing and access road -	$15,000.00
9,500 lin. ft. of 6" Watermain, Class 150, furnished & laid complete, incl. valves & fittings, @$3.50 per lin. ft. from well site to Village S. limits -	$33,250.00
Total for Construction - - - - -	$49,250.00
15% for Incidentals & Contingencies - - - -	$ 7,390.00
TOTAL ESTIMATE	$56,640.00

Estimated Annual Charges:-

Interest on Capital (5¼%) ------------------------		$ 2,974.00
Sinking Fund (2%) ------------------------------		$ 1,133.00
Reserve Fund (1½%) -----------------------------		$ 850.00
Annual Operating Costs:		
(1) Power	$400.00	
(2) Chlorine	$200.00	
(3) Op. sal.	$600.00	
Total Annual Operating Costs ----------		$ 1,200.00
TOTAL ANNUAL CHARGES ------------------		$ 6,157.00

Based on an estimated 56,000 g.p.d., the total annual consumption would be 56,000 x 365 = 20,500,000 gal. and

The rate per 1,000 gallons would be ------------ 30.0 cts.

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APPENDIX II

ESTIMATE OF COST

of a WATER SUPPLY for the VILLAGE OF THEDFORD
from a possible well supply near lots 28 & 29. Con. 3.
in the TOWNSHIP OF BOSANQUET

Purchase of well sites & other necessary lands- -	$ 2,000.00
Drilling & casing of wells, etc; pump & motor ; pumphouse; power supply line; chlorinator; controls; meter; valves & piping complete; including fence and access road -	$ 15,000.00
11,100 lin. ft. of 8" Watermain, Class 150, furnished & laid compl. including valves & fittings & branches from well site to Village N. limits, @ $4.50 per lin. ft. - - - - - - - - - - - - -	$ 49,950.00
Total for Construction- -	$ 66,950.00
15% for Incidentals & Contingencies - - - -	$ 10,050.00
TOTAL ESTIMATE	$ 77,000.00

Estimated Annual Charges:-

Interest on Capital (5¼%) ----------------------	$ 4,042.00
Sinking Fund (2%) ------------------------------	$ 1,540.00
Reserve Fund (1½%) -----------------------------	$ 1,155.00

Annual Operating Costs:

(1) Power	$400.00
(2) Chlorine	$200.00
(3) Operator's Salary	$600.00

Total Annual Operating Costs ---------	$ 1,200.00
TOTAL ANNUAL CHARGES -----------------	$ 7,937.00

Based on an estimated annual consumption of 20,500,000 gallons, the rate would be ------------------------------ 38.7 cts. per 1,000 gallons.

APPENDIX III

ESTIMATE OF COST

of an INTERNAL DISTRIBUTION SYSTEM IN THE VILLAGE of THEDFORD

15,900 lin. ft. of 6" Watermain, Class 150, furnished and laid complete, including valves & fittings, @ $3.50 per lin. ft.	$ 55,650.00
6,200 lin. ft. of 4" Watermain, Class 150, furnished & laid complete, including valves and fittings, @ $2.70 per lin. ft.	$ 16,740.00
25 Hydrants, installed complete, including valves, fittings and branches, @ $350.00 each	$ 8,750.00
110-3/4" Copper Service Connections, 16'-0" long, @ $40.00 each	$ 4,400.00
88-3/4" Copper Service Connections, 50'-0" long, @ $80.00 each	$ 7,040.00
Total for Construction	$ 92,580.00
15% for Incidentals & Contingencies	$ 13,887.00
TOTAL ESTIMATE	$106,467.00
Chargeable for Private Service Connections	$ 13,156.00
Estimated annual charge for Private Service Connections	$ 1,151.00
Estimated Annual Charges on Balance of $93,311.00:	
Interest on Capital (5¼%)	$ 4,899.00
Sinking Fund (2%)	$ 1,866.00
Reserve Fund (1½%)	$ 1,400.00

Appendix III (Cont'd.):-

Annual Operating Costs:

(1) Billing & collecting	$ 2,400.00	
(2) Repairs & maintenance	$ 500.00	
Total Annual Operating Costs-----------		$ 2,900.00
TOTAL ANNUAL CHARGES -----------------		$ 11,065.00

Based on an annual consumption of 20,500,000 gallons, the additional charge on water rates would be -------- 54.0 cts. per 1,000 gallons.

APPENDIX IV

ESTIMATE OF COST

of a WATERWORKS SYSTEM for the TOWN of FOREST and the VILLAGE of WATFORD with an intake in Lake Huron

Purchase of land for waterworks plant site	$ 5,000.00
Intake crib, constructed complete	$ 5,000.00
2,000 lin. ft. of 16" C.I. Intake, complete @ $35.00 per lin. ft.	$ 70,000.00
Low lift pumphouse & pumpwell complete including screens, pump, chlorinator, and controls	$ 85,000.00
Circular 40' ø Clarifier, alum feeder, meters, valves & piping	$ 52,000.00
Clear well, High Lift pumphouse, high lift pumps, meter and controls	$ 90,000.00
26,400 lin. ft. of 10" cement-lined C.I. pipe, Class 150, to Forest ground reservoirs, including valves & fittings, @ $5.50 per lin. ft.	$158,400.00
250,000 gallon ground storage reservoir at Forest, for Watford line, constructed complete	$ 40,200.00
High lift pumphouse and pumps, including meter and controls, at reservoir	$ 22,000.00
Easements for pipeline to Watford	$ 20,000.00
61,700 lin. ft. of 8" cement-lined C.I. pipe, Class 150, from Forest to Watford ground reservoir, including valves & fittings, @ $4.50 per lin. ft.	$277,650.00
Total for Construction	$825,250.00
15% for Incidentals & Contingencies	$123,750.00
TOTAL ESTIMATE	$949,000.00

Appendix IV (Cont'd):-

Joint Capital Costs-----------------------------$535,210.00

Joint Annual Charges:

Interest on capital (5¼%) -------------------- $ 28,098.00

Sinking Fund (2%) ---------------------------- $ 10,704.00

Reserve Fund (1½%) --------------------------- $ 8,028.00

Annual Operating Costs:

(1) Power, fuel & light	$6,000.00
(2) Chlorine & chemicals	$4,000.00
(3) Operator's salaries	$5,000.00
(4) Miscellaneous	$ 500.00

Total annual operating costs --------------- $ 15,500.00

TOTAL JOINT ANNUAL CHARGES -------- $ 62,330.00

1956 Eonsumptions - -	Forest (actual)	37,395,000 gallons
	Watford	26,000,000 "
	Total	63,395,000 "

$$\text{Forest's share} = \frac{37{,}395}{63{,}395} = 58.98\% \times \$62{,}330.00 = \$36{,}762.00$$

$$\text{Watford's share} = \frac{26{,}000}{63{,}395} = 41.02\% \times \$62{,}330.00 = \underline{\$25{,}568.00}$$

$62,330.00

The above represents the complete price of water to Forest, e.g. about 98.3 cts. per 1,000 gallons, or since there are about 736 connections in Forest, a cost per connection of

-----------$50.00

Watford Direct Costs ------------------------- $413,790.00

Watford Direct Annual Charges:

Interest on Capital (5¼%) -------------------- $ 21,724.00

Sinking Fund (2%) ---------------------------- $ 8,028.00

Reserve Fund (1½%) --------------------------- $ 6,207.00

Appendix IV (Cont'd.):-

Annual operating costs:

(1) Power	$ 900.00
(2) Operator's sal.	$ 300.00

Total Annual Operating Costs ------	$ 1,200.00
Total Watford Direct Annual Charges	$ 37,159.00
Total Watford Joint Annual Charges	$ 25,568.00
TOTAL ANNUAL CHARGES to WATFORD ...	$ 62,727.00

Based on an estimated annual consumption of 26,000,00 gallons, the rate per 1,000 gallons would be --------- $ 2.41

APPENDIX V

ESTIMATE OF COST

of a WATERWORKS SYSTEM for the TOWN of WATFORD from a possible well supply at the Townline Road between the Counties of Lambton and Middlesex

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Purchase of well sites & other necessary land	$ 2,000.00
Drilling & Casing well; pump & motor; pumphouse; power supply line; chlorinator; controls on meter; valves & piping; complete including fencing & road	$ 19,000.00
29,500 lin. ft. of 8" cement-lined C.I. Pipe, Class 150, including valves & fittings (via Hwy. #22 and County line road)@ $4.50 per.lin. ft.	$132,750.00
Total for Construction	$153,750.00
15% for Incidentals & Contingencies	$ 23,060.00
TOTAL ESTIMATE	$176,810.00

Estimated Annual Charges:-

Interest on Capital (5¼%)	$ 9,282.00
Sinking Fund (2%)	$ 3,536.00
Reserve Fund (1½%)	$ 2,652.00

Annual operating costs:

(1) Power	$900.00
(2) Chlorine	$600.00
(3) Operator's sal.	$600.00

Total annual operating costs	$ 2,100.00
TOTAL ANNUAL CHARGES	$ 17,570.00

Based on an estimated annual consumption of 26,000,000gal.

the rate per 1,000 gallons would be --------- 67.6 cts.

APPENDIX VI

ESTIMATE OF COST

of a WATERWORKS SYSTEM for the TOWN of FOREST only with an intake in Lake Huron

Land for Waterworks plant site	$ 5,000.00
Intake crib, constructed complete	$ 5,000.00
2,000 lin. ft. of 12" C.I. intake, @ $30.00 per. lin. ft.	$ 60,000.00
Low lift pumphouse & pumpwell complete, including screens, pump, chlorinator & controls	$ 67,000.00
Circular 35' ø Clarifier; alum feeder; motors, valves & piping	$ 46,000.00
Clear well, high lift pumphouse, high lift pumps, meter and controls	$ 48,000.00
26,400 lin. ft. of 8" cement-lined C.I. pipe, Class 150, to Forest reservoir, including valves & fittings, @ $4.50 per lin. ft.	$118,800.00
Total for Construction	$349,800.00
15% for Incidentals & Contingencies	$ 52,470.00
TOTAL ESTIMATE	$402,270.00

Estimated Annual Charges:

Interest on Capital (5¼%)		$ 21,192.00
Sinking Fund (2%)		$ 8,045.00
Reserve Fund (1½%)		$ 6,034.00
Annual Operating Costs:-		
(1) Power, fuel & light	$3,500.00	
(2) Chlorine & chemicals	$2,500.00	
(3) Operator's salary	$5,000.00	
Total Annual Operating Costs		$ 11,500.00
TOTAL ANNUAL CHARGES		$ 46,771.00

Based on an estimated consumption of 37,395,000 gallons per year, the rate per 1,000 gallons would be -------- $ 1.25

APPENDIX VII

ESTIMATE OF COST

of a WATER SUPPLY to the VILLAGE of BRIGDEN
by means of a pipeline from the Town of Petrolia

44,900 lin. ft. of 8" cement-lined C.I. watermain, Class 150, furnished & laid complete, including valves & fittings, @ $4.50 per lin. ft. - - - - -	$202,050.00
Land for easements and rights-of-way (50,000 ft. @ .20cts. per ft.) - - - - - - - - -	$ 10,000.00
Pumping station in Petrolia, complete including pumps, motors, controls & building -	$ 9,000.00
1 - 6" meter & vault, constructed complete, including valves, fittings, & by-pass -	$ 2,500.00
Total for Construction - -	$223,550.00
15% for Incidentals & Contingencies - - -	$ 33,530.00
TOTAL ESTIMATE	$257,080.00

Estimated Annual Charges:

Interest on Capital (5¼%) -------------------	$ 13,497.00
Sinking Fund (2%) --------------------------	$ 5,162.00
Reserve Fund (1½%) -------------------------	$ 3,856.00
Annual Operating Costs ---------------------	$ 800.00
TOTAL ANNUAL CHARGES	$ 23,315.00

Estimated cost of transmitting water @15 MG/yr-$1.55/1,000 gal.
Estimated cost of purchasing water from Petrolia .30/ " "

Total Cost of Water ....$ 1.85 per 1,000 gallons.

APPENDIX VIII

ESTIMATE OF COST

of a WATERWORKS SYSTEM for part of MOORE TOWNSHIP and the VILLAGE of BRIGDEN, with an intake in the St. Clair River and a water filtration plant near Mooretown

FILTRATION PLANT

Land for filter plant site & easement	$ 5,000.00
24" Intake, 600 ft. long (300 ft. on land & 300 ft. in water) & crib	$ 30,000.00
Low Lift pumping station, complete	$ 70,000.00
½ M.G.D. circular clarifier, mixer & alum feeder	$ 45,000.00
½ M.G.D. water filtration plant, complete including wash water & high lift pumps, chlorinators, & ¼ M.G. storage reservoir	$145,000.00
Total for Filtration Plant	$295,000.00
15% for Incidentals & Contingencies	$ 44,250.00
TOTAL COST OF FILTRATION PLANT	$339,250.00

WATERMAIN to CORUNNA

18,500 lin. ft. of 10" watermain, Class 150, furnished & laid complete, including valves & fittings, etc.,@ $5.50 per. lin. ft.	$101,750.00
1 - 6" Meter and Vault, constructed complete, including valves, fittings & by-pass	$ 2,500.00
Total for Construction	$104,250.00
15% for Incidentals & Contingencies	$ 15,650.00
TOTAL ESTIMATE	$119,900.00

Appendix VIII (Cont'd.):-

WATERMAIN to COURTRIGHT

10,000 lin. ft. of 10" watermain Class 150, furnished & laid complete, including valves, fittings, etc.,@ $5.50 per. lin. ft.	$ 55,000.00
1 - 6" Meter & Vault, constructed complete, including valves, fittings & by-pass	$ 2,500.00
Total for Construction	$ 57,500.00
15% for Incidentals & Contingencies	$ 8,625.00
TOTAL ESTIMATE	$ 66,125.00

WATERMAIN to BRIGDEN

51,800 lin. ft. of 8" cement-lined watermain, Class 150, furnished & laid complete, including valves & fittings,@ $4.50 per. lin. ft.	$233,100.00
1 - 6" Meter & Vault, constructed complete, including valves, fittings & by-pass	$ 2,500.00
Total for Construction	$235,600.00
15% for Incidentals & Contingencies	$ 35,340.00
TOTAL ESTIMATE	$270,940.00

PRESENT CONSUMPTION YEARLY

Northern Area:

Canadian Oil Co.	60,000,000 gal.
Corunna	40,000,000 "
Mooretown	5,000,000 "
Twp.of Moore between Corunna & Mooretown	7,000,000Gal.
	112,000,000 gal.=77.3%

Southern Area:

Twp. of Moore between Mooretown & Courtright	3,000,000 gal.
Courtright	15,000,000 "
	18,000,000 gal. = 12.4%

Appendix VIII (Cont'd.):-

Eastern Area:

Brigden ---------------------------- 15,000,000 gal.=10.3%

145,000,000 gal.-100%

ESTIMATED ANNUAL OPERATING COSTS OF FILTER PLANT

Power, fuel & light -------------$ 4,500.00
Chlorine & chemicals ------------$ 2,500.00
Miscellaneous -------------------$ 500.00
Operator's salary ---------------$ 6,500.00

Total annual operating costs -----------$14,000.00

NORTHERN AREA SHARE

77.3% of Plant = 77.3% x $339,250.00 - - - - -$262,240.00

Main to Corunna - - - - - - - - - - - - - - - - - - $119,900.00

Total Capital Cost $382,140.00

Estimated Annual Charge for Northern Area:-

Interest on Capital (5¼%) ------------------- $ 20,062.00

Sinking Fund (2%)--------------------------- $ 7,643.00

Reserve Fund (1½%) ------------------------- $ 5,732.00

Annual Operating Costs(77.3% of $14,000.00)-- $ 10,822.00

Total Annual Charges .... $ 44,259.00

Total estimated annual consumption of water in

Northern Area is -------------------------- 112,000,000 gal.

Estimated cost of water to Northern Area-39.5 cts. per 1,000 gal.

SOUTHERN AREA SHARE

12.4% of Plant= 12.4% of $339,250.00 - - - - -$ 42,067.00

$\frac{18}{33}$ of mains to Courtright= $\frac{18}{33}$ x $66,125.00 - -$ 36,068.00

Total Capital Cost ....$ 78,135.00

Appendix VIII (Cont'd.):-

Estimated Annual Charges To Southern Area:-

Interest on Capital (5¼%)	$ 4,102.00
Sinking Fund (2%)	$ 1,563.00
Reserve Fund (1½%)	$ 1,172.00
Annual Operating Costs (12.4% of $14,000.00)	$ 1,736.00
Total Annual Charges	$ 8,573.00

Total estimated annual consumption of water in Southern Area is ---------------------------------- 18,000,000 gal.

Estimated cost of water to Southern Area is- 47.6 cts. per 1,000 gal.

EASTERN AREA SHARE (Brigden)

10.3% of Plant = 10.3% of $339,250.00	$ 34,943.00
$\frac{15}{33}$ of main to Courtright = $\frac{15}{33}$ x $66,125.00	$ 30,057.00
Mains to Brigden	$270,940.00
Total Capital Cost	$335,940.00

Estimated Annual Charges to Eastern Area:-

Interest on Capital (5¼%)	$ 17,637.00
Sinking Fund (2%)	$ 6,719.00
Reserve Fund (1½%)	$ 5,039.00
Annual Operating Costs (10.3% of $14,000)	$ 1,442.00
Total Annual Charges	$ 30,837.00

Total Estimated annual consumption of water in Eastern Area is -------------------------------15,000,000 gal.

Estimated cost of water to Eastern Area is - $2.06 per 1,000 gal.

APPENDIX IX

ESTIMATE OF COST

of a WATER SUPPLY MAIN from CORUNNA to COURTRIGHT in the Township of Moore

---

28,500 lin. ft. of 10" cement-lined watermain, Class 150, furnished & laid complete, including valves & fittings, @ $5.50 per. lin. ft. - - - -$156,750.00

15% for Incidentals & Contingencies - - - -$ 23,510.00

TOTAL ESTIMATE $180,260.00

Interest on Capital (5¼%) ------------------- $ 9,464.00

Sinking Fund (2%) -------------------------- $ 3,605.00

Reserve Fund (1½%) ------------------------- $ 2,704.00

Total Annual Charges .... $ 15,773.00

Estimated Consumption:

Mooretown	5 MG
Moore Twp.	10 "
Courtright	15 "
Brigden	15 "
	45 MG/yr.

Cost of water - 35.0 cts. in addition to price paid to Canadian Oil Co. of about 30 cts.

Total 65 cts. per 1,000 gallons.

Additional Cost to Brigden for mains - - - - -$270,940.00

" " " " for pumping station-$ 20,000.00

Total $290,940.00

Additional annual charge to Brigden at 8-3/4% of above total, plus annual operating costs of pumphouse-$25,457.00

Total charge to Brigden = $1.70 + .65 -----$2.35 per 1,000 gal.

APPENDIX X

ESTIMATE OF COST

of a WATER SUPPLY SYSTEM for the VILLAGE of BRIGDEN from a possible well source located within two miles of the Village

---

10,000 lin. ft. of 6" C.I. Watermain, Class 150, furnished & laid complete, including valves, fittings & branches @ $3.50 per lin. ft.		$35,000.00
Drilling & casing well; pump & motor; power supply line; chlorinator; controls & meter, valves & piping; complete including fencing & road		$15,000.00
Purchase of well site and easements		$ 2,000.00
Total for Construction		$52,000.00
15% for Incidentals & Contingencies		$ 7,800.00
TOTAL ESTIMATE		$59,800.00
Estimated Annual Charges:-		
Interest on Capital (5¼%)		$ 3,140.00
Sinking Fund (2%)		$ 1,196.00
Reserve Fund (1½%)		$ 897.00
Annual Operating Charges:		
(1) Power	$ 400.00	
(2) Chlorine	$ 200.00	
(3) Operator's salary	$600.00	
Total annual operating charges		$ 1,200.00
TOTAL ANNUAL CHARGES		$ 6,433.00

Based on an estimated annual consumption of 15 M.G., the cost of water would be ------------------------ 42.9 cts. per 1,000 gallons.

SUMMARY OF COSTS

MUNICIPALITY	SEE APPENDIX	SOURCE OF SUPPLY	NATURE OF WORKS	CAPITAL COST	ANNUAL COST	COST PER 1,000 Gals.
Petrolia (Town)	not included	Lake Huron ($12\frac{1}{2}$ miles from town) (existing)	Includes Intake Lowlift Pumps Highlift Pumps Pumping Station Settling Tank Chlorination $12\frac{1}{2}$ miles of 12" C.I. pipe line 750,000 gallon surge tank 250,000 gallon stand pipe Distribution System Ave. demand-0.332 M.G.D. Max. demand-1.5 M.G.D			$ .43
Wyoming (Village)	not included	Individual Private dug and drilled wells	Might take from Petrolia pipe line			
Alvinston (Village)	not included	Domestic supply Individual dug and drilled wells Fire Supply from Sydenham River	Pump House distribution system. Need to explore for ground water for domestic supply			
Arkona (Village)	not included	Individual private wells	Supply should come from wells			
Thedford (Village)	-	Individual private wells are present source of supply				

SUMMARY OF COSTS

MUNICIPALITY	SEE APPENDIX	SOURCE OF SUPPLY	NATURE OF WORKS	CAPITAL COST	ANNUAL COST	COST PER 1000 Gals.
Thedford (cont'd.)	I	Well supply (Lots 14 & 15 Con. 3 Bosanquet Twp.	Purchase of sites & land-drilling, pump-house and supply main	$ 56,640.	$ 6,157.	$ .30
	II	Well Supply (Lots 28 & 29 Con. 3 Bosanquet Twp.	"	$ 77,000.	$ 7,937.	$ .38 7/10
	III	See Above	Internal distribution system - water mains valves, hydrants, service connections	$ 106,467. for system only	$ 11,065.	$ .54 & cost of supply
Watford (Town)	-	3 Drilled Wells (unsatisfactory)	Pumps, Pumping Station de-gasifier, 230,000 gal. surface storage tank, 15,000 gal. -elevated tank- distribution system	existing	-	-
Watford & Forest	IV	Lake Huron (joint scheme with town of Forest)	Purchase of land Intake, low lift pump house, clear well high lift pump house-pumps, supply lines-surface reservoir-Easements	$ 535,210. (joint) Watford direct costs $ 413,719	$ 62,330. (joint) Watford direct costs $ 62,727.	- Watford $ 2.41 Forest $ .98 3/10
Watford (Town)	V	Deep Well (Town line road between Lambton & Middlesex Counties)	Purchase of land, well sites, drilling, pump house, pumping equipment, supply main	$ 176,810.	$ 17,570.	$ .67 6/10
Forest (Town)	-	Deep Wells - existing -	Wells, air-lift pumps pump house collecting chamber pumps, surface reservoir, stand pipe distribution system	-	-	-

SUMMARY OF COSTS

MUNICIPALITY	SEE APPENDIX	SOURCE OF SUPPLY	NATURE OF WORKS	CAPITAL COST	ANNUAL COST	COST PER 1000 gals.
Forest (cont'd) (Town)	IV	Lake Huron (joint scheme with town of Watford)	See above - Watford & Forest	-	-	-
	VI	Lake Huron	Land - Intake L.L. Pumphouse pumps, clear well, High lift pump-house pumps, supply main	$ 402,270.	$ 46,771.	$ 1.25
Brigden (Police Village)	-	Drilled Wells (4 of 7 producing) - existing - (inadequate)	Wells, Well Pumps, high lift Pump House, high lift pumps, surface reservoir (70,000 gals.) distribution system	-	-	-
	VII	Pipe line from Petrolia	Supply main, land, easements Pumping Station, Pumping equipment	$ 257,080.	$ 23,315.	$ 1.85
	VIII	St. Clair River	To supply Pt. of Moore Twp. & Brigden Filtration Plant Pumping Station Supply main	$ 335,940.	$ 30,837.	$ 2.06
	IX		Sarnia Supply Pipeline - Pumping Station	$ 290,940.	$ 25,457.	$ 2.35
	X	Drilled Well (within 2 miles of Brigden)	Land, drilling supply main	$ 59,800.	$ 6,433.	$ .42 9/10
Moore Township	VIII	St. Clair River	Intake & Filtration plant near Mooretown (joint scheme)	$ 382,140.	$ 44,259.	$ .39 5/10

SUMMARY OF COSTS

MUNICIPALITY	SEE APPENDIX	SOURCE OF SUPPLY	NATURE OF WORKS	CAPITAL COST	ANNUAL COST	COST PER 1000 Gals.
Moore Township(contd)						
(1) Northern area including Corunna Village, Canadian Oil Company. Mooretown & part of township			Pipe lines to Corunna, Courtright & Brigden			
(2) Southern Area including Courtright	VIII			$ 78,135.	$ 8,573.	$ .47 6/10
(3) Eastern Area (see Brigden)				$ 335,940.	$ 30,837.	$ 2.06
Courtright	IX		Sarnia Supply Pipe line from Corunna to Courtright	$ 180,260.	$ 15,773.	$ .65